

## Cultural Alteration of Human Teeth in the Mariana Islands

RONA IKEHARA-QUEBRAL\* AND MICHELE TOOMAY DOUGLAS  
*International Archaeological Research Institute, Inc.,  
Honolulu, Hawaii 96826*

**KEY WORDS** dental modification; abrading; transverse filing; incising; Micronesia

**ABSTRACT** Evidence of cultural dental modification in a precontact (pre-1521) skeletal sample from the Academy of Our Lady of Guam gymnasium site in Agana, Guam, is documented. Two of the four individuals recovered at the Academy Gym site exhibit modification of the maxillary teeth. One individual displays vertical incising of a single tooth, and the other exhibits horizontal abrading of the anterior teeth which may be a purposeful or an incidental alteration. Although deliberate alteration of the dentition, including tooth extraction, notching, filing, and drilling, has been documented in human groups worldwide, little has been written about these cultural practices in the Mariana Islands. Examination of the available literature on precontact human remains from the region reveals at least three patterns of dental incising and similar cases of dental abrasion. While the origins of these practices are not known, the presence and style of these cultural alterations may be sex-specific, cosmetic in nature, or an indication of status in a ranked society. Alternatively, they may signify membership in a particular group or lineage, or mark a rite of passage. Because the comparative samples are limited in number and small, and the provenience of many of the skeletons is obscure, temporal variation cannot be ruled out. *Am J Phys Anthropol* 104:381-391, 1997. © 1997 Wiley-Liss, Inc.

Deliberate modification of human teeth has been described in populations worldwide. Intentional alteration of traumatic origin, including tooth extraction and modification of the tooth surface or shape (e.g., by notching, grooving, grinding, or drilling), has been documented in populations from Africa, the Americas, India, the Malay Archipelago, the Philippines, New Guinea, Japan, and Oceania (Merbs, 1989; Milner and Larsen, 1991; Romero, 1970; Ubelaker, 1989). Yet very little has been written about these practices in Mariana Islanders.

In this study cultural alteration of human teeth is described in a small precontact (pre-1521) sample from Agana, Guam. Similar modifications observed in other dental

remains from the Mariana Islands are summarized from the available literature (Anderson, 1992; Birkby, 1977; Hanson, 1988, 1989; Leigh, 1929; Pietrusewsky, 1986b; Pietrusewsky and Batista, 1980; Roy, 1989; Tayles and Roy, 1989). Dental remains from the SNM Hotel project area, Rota, were analyzed for the present study.

The Mariana Islands, located in Western Micronesia, lie to the north of the Caroline Islands and to the east of the Philippines (Fig. 1). The Mariana Archipelago comprises the island of Guam and 20 islands of Com-

\*Correspondence to: Rona Ikehara-Quebral, International Archaeological Research Institute, Inc., 949 McCully Street, Suite 5, Honolulu, HI 96826. E-mail: rikehara@hawaii.edu

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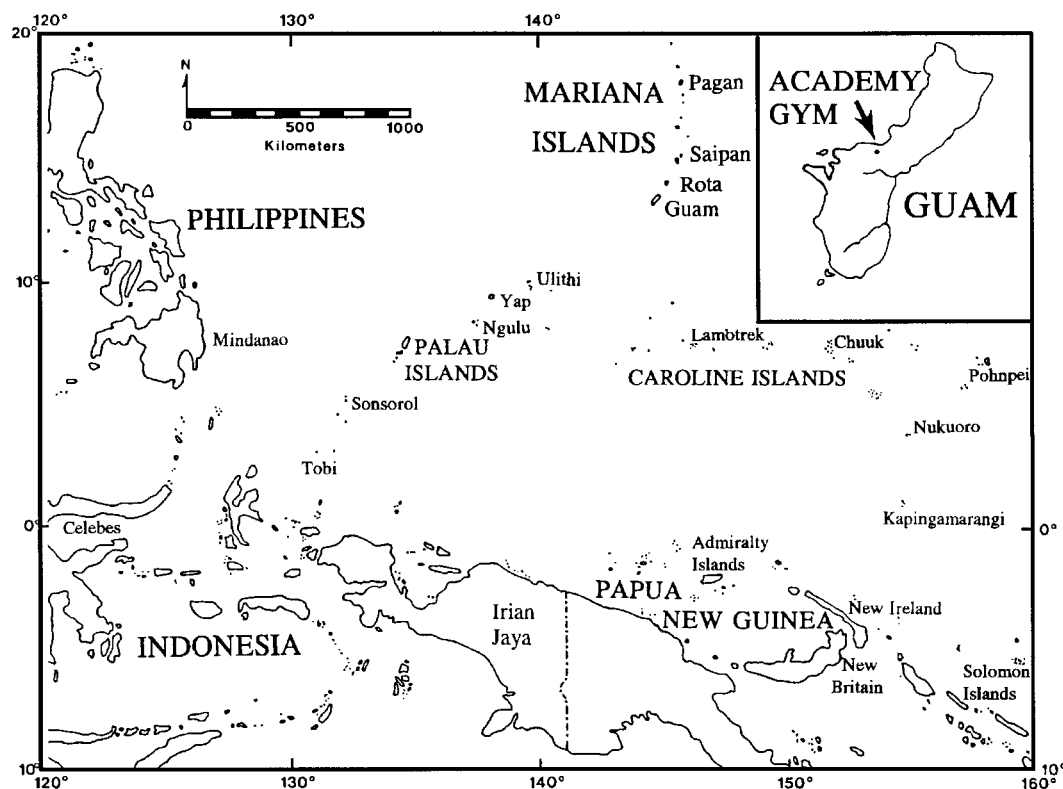


Fig. 1. Map of the Western Pacific showing the Marianas Archipelago.

monwealth of the Northern Marianas, extending 13–20°N latitude (Karolle, n.d.). Recent archaeological investigations securely date initial human occupation in the Mariana Islands to about 3500–3600 BP (Athens and Ward, 1997; Butler, 1995; Intoh, 1997). The first recorded European contact with the indigenous Chamorro people of the Marianas occurred in 1521 with the arrival of Ferdinand Magellan, a Portuguese explorer whose expedition was funded by Spain.

Horizontal abrading and incising are two types of dental modifications found in the Mariana Islands. Horizontal abrading or filing is defined here as a transverse back-and-forth motion using a rounded or blunted tool, which results in a concave or extensively grooved surface. Abrading or filing of the labial enamel tooth surface may be incidental or deliberate. Incidental or unintentional abrasion may occur during cleaning of the teeth, prompted by surface staining (e.g., betel nut stains). Dental cleaning

with the internal shell of cuttlefish or squid, pumice, ash, sand or a burnt stick has been documented in Micronesians and Polynesians living on Ocean Island, Kiribati (Sutton, 1979). A concave enamel surface in the transverse direction is produced by rubbing against the tooth with a stick, eventually exposing the dentin. The mandibular teeth are usually not affected by these cleaning processes. Incidental abrading may be difficult to distinguish from intentional alteration.

To distinguish the wide, concave horizontal abrasions from the thin vertical and diagonal grooves, the term "incising" will be used in reference to thin grooves made with a sharp implement. Although a filing motion was probably used to "cut" the tooth surface, this motion may be likened to "cutting" bone in a back-and-forth motion using a sharp tool. In an experiment one author (RIQ) used a sharp piece of volcanic glass to cut the enamel surface of a mammal tooth. In Guam

TABLE 1. Marianas samples without cultural dental alteration

Island	Site	No. of adults			No. of subadults	Maxillary incisors + canines	Reference
		Males	Females	? Sex			
Guam	Apurguan	53	43	5	51	290	Pietrusewsky et al., 1992
	Fujita	12	9	3	4	49	Pietrusewsky, 1986a
	Right-of-Way	4	6	0	6	17	Pietrusewsky, 1986a
	Leo Palace	10	5	1	11	106	Douglas and Ikehara, 1992
	San Antonio	2	3	2+	1	30	Hanson, 1991
	ABC Condo	1	0	0	0	0	Heathcote, 1990
Rota	Songsong	1	9	0	2	28	Pietrusewsky, 1988
Tinian	Latte House	0	3	0	3	30	Pietrusewsky and Batista, 1980
Saipan	Oleai	19	10	1	5	55	Pietrusewsky and Douglas, 1989
	Grotto Site	1	1	0	0	12	Pietrusewsky and Batista, 1980
	Tanapag	5	1	1	—	2	Pietrusewsky, 1986b
	Achugao	2	4	1	2	3	Hanson, 1995
	T. Villanueva, San Antonio	0	0	0	2	4	Roy, 1989

chert and basalt flakes have been recovered archaeologically and a precontact (pre-1521) chert source and quarry has been documented (Beardsley, 1993). Chert, a material much harder than volcanic glass, may have been used to incise teeth in the Mariana Islands.

## MATERIALS AND METHODS

### Academy Gym, Guam

In 1991 the skeletal remains of four individuals (three adults, one subadult) were unearthed at the proposed gymnasium site of the Academy of Our Lady of Guam (Welch, 1991). The Academy Gym site is located in central Agana, on the western coast of Guam, Mariana Islands (Fig. 1). The remains were found in a precontact cultural layer and are believed to be approximately contemporaneous.

While dental remains were recovered for only two of the four individuals from Academy Gym (Burials AG-43 and AG-20), both exhibit unusual alteration in tooth morphology, which will be described in detail in the Results section. Burial AG-43, a 19–35-year-old female, is represented by very incomplete skeletal and dental remains. None of her teeth are stained from chewing betel nut, a practice common in Western Micronesia. Abrading of the teeth is observed in the

anterior maxillary teeth of Burial AG-43. Burial AG-20, a 35–40-year-old male of probable Chamorro ancestry, is represented by a substantially complete skeleton, although much of it is fragmented. The estimated living stature of this individual is 175 cm (5 ft 9 in) using Maori regression formulae (Houghton et al., 1975). Stafne's defect (Finnegan and Marcsik, 1980) is observed on the left mandible and bilateral spondylolysis is present in the fifth lumbar vertebra. Most of his teeth are stained a light reddish-brown, presumably from chewing betel nut. Dental incising is observed in Burial AG-20. Both individuals had relatively good dental health.

To determine the extent of dental modification in the Mariana Islands, the available literature on dental samples from four islands (Guam, Rota, Tinian, and Saipan) was surveyed (Tables 1 and 2). For the present study, only the teeth from the Academy Gym and SNM Hotel sites were available for observation by at least one of the authors. Photographs and descriptions of modified teeth, mostly from unpublished osteology reports, were used to determine the type of alteration patterns in the rest of the samples. The number of individuals and teeth affected and the type of dental modification, horizontal abrading or incising, were recorded for each site.

TABLE 2. Cultural dental alteration observed in the Mariana Islands

Site	Dates	Site Mini	No. of affected individuals		Reference(s)
			Abrading	Incising	
Guam					
Academy Gym	Precontact (pre-1521)	4	1	1	Present study; Welch, 1991
Nomna Bay	Predates AD 880	3	3	—	Birkby, 1977
Gognga-Gun Beach	AD 950–1450	100	1	3	Anderson, 1992, pers. comm. 1993
Island-wide sample	Precontact	106	—	1	Leigh, 1929
Matapang Beach Park	Precontact	20	1?	—	Pietrusewsky, 1986a
Rota					
Antonio Tudella	Precontact–early historic	3	1	—	Hanson, 1988
Romano Maratita	Precontact–early historic	2	—	1	Hanson, 1988
SNM Hotel	AD 1420–1660	2	—	1	Present study; Craib, in prep.; Pietrusewsky, 1994
Saipan					
Duty Free Site	AD 1000–1521	9	—	2	Hanson, 1989
Hafa Dai Beach Hotel	Precontact	20	—	1	Pietrusewsky, 1986b
Afetna, San Antonio	AD 650	46	—	3	Tayles and Roy, 1989
San Antonio	AD 1230–1360 ± 100	33	12	—	Pietrusewsky and Batista, 1980; Roy, 1989

## RESULTS

Deliberate alterations of the teeth are documented in several samples from Guam, Rota, and Saipan (Fig. 2). The lack of modified dentition from Tinian may be attributed to the paucity of archaeological skeletal and dental samples from that island. Table 2 summarizes the occurrence of incising and horizontal abrading in the surveyed Mariana samples. Most of the samples are from the precontact (pre-1521) period. Two of the samples from Rota are late precontact to early historic.

### Horizontal abrading

**Guam.** Burial AG-43, an adult female from the Academy Gym site, has evidence of horizontal filing of the maxillary incisors, canines, and left first premolar (Fig. 3). The labial enamel surfaces of the upper incisors and canines have been filed in the transverse direction with a rounded tool, resulting in a slightly concave, grooved surface. The distinct grooving spans most of the tooth surface and exposes much of the dentin. The left first premolar has a probable secondary abrasion from filing of the left canine. The molars are not affected. Microscopic analysis of the tooth surfaces reveals a second transverse filing surface, with a slight change in the angle of filing. While unintentional damage from cleaning tooth stains cannot be ruled out, this appears unlikely as there is no residual staining or

discoloring of any of the unabraded tooth surfaces.

In a precontact sample from Nomna Bay, Guam, six loose teeth (of at least three individuals of indeterminate sex) exhibit a horizontal groove on the labial enamel sur-

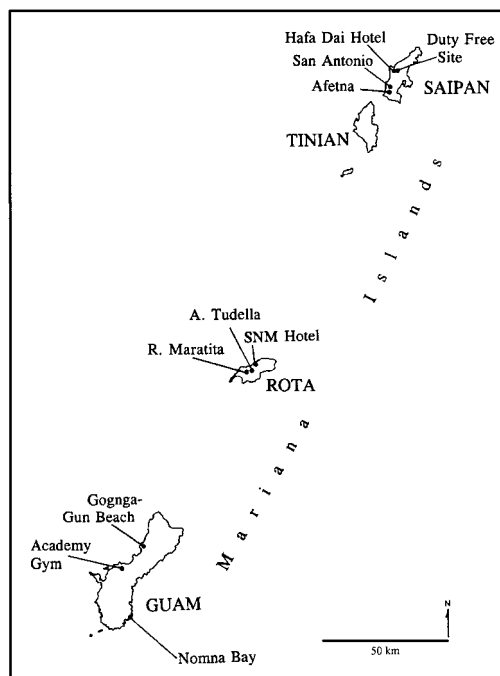


Fig. 2. Map of Guam, Rota, and Saipan showing the distribution of sites with dental modification in the Mariana Islands.

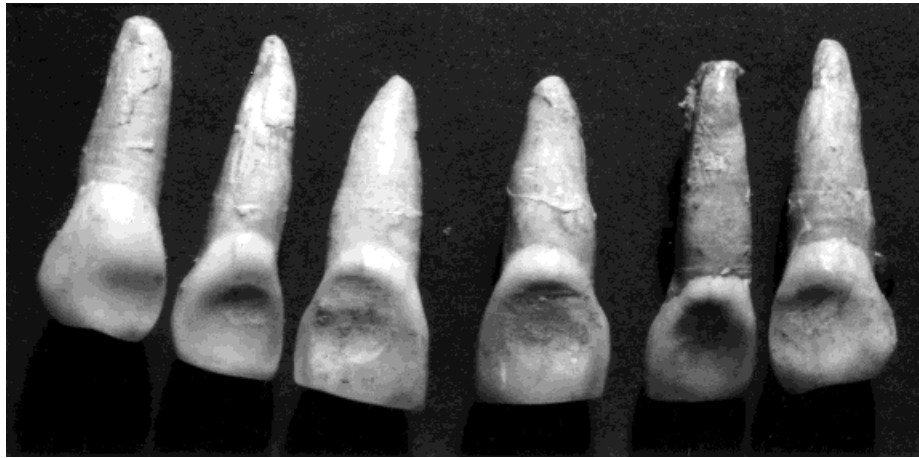


Fig. 3. Transverse filing of the labial surface of the maxillary incisors, canines, and left first premolar of an adult female from the Academy Gym site, Agaña, Guam. Teeth enlarged 2 $\times$ . Photo by Roger Blankfein.

face characteristic of "antemortem grinding or file mutilation marks" (Birkby, 1977:169). The maxillary teeth affected are a central incisor, two canines, and a second premolar. The mandibular teeth affected are a lateral incisor and a canine. The dentin is exposed in four of the teeth. Incidental abrasion cannot be ruled out. The burials tentatively predate AD 880 and possibly predate AD 490 (Reinman, 1977, pers. comm. 1993).

In a precontact sample of over 100 individuals from Gognga-Gun Beach, Guam, an adult of indeterminate sex exhibits transverse filing of the maxillary incisors through first molars, exposing the dentin in the anterior teeth (Anderson, 1992, pers. comm. 1993). The concave groove surfaces are similar to the modification observed in Academy Gym Burial AG-43. One premolar and one canine were not recovered. The Gognga-Gun Beach site dates to AD 950–1450 (Anderson, 1992).

In a report describing a precontact sample of 20 individuals (18 adults, two subadults) from Matapang Beach Park, Guam, the appended burial description for an adult female briefly mentions "anterior teeth filed" (Pietrusewsky, 1986a). However, this modification is not discussed in the text of the report and no photographs were included. Therefore, this individual has been omitted from the comparative frequencies of dental modification.

**Rota.** In Rota, evidence of dental abrasion is found in one of three very incomplete secondary burials in a late precontact to early historic sample from Antonio Tudella. An adult male exhibits filing of the labial enamel surfaces of the maxillary canines. Microscopic examination revealed numerous fine striations in the horizontal direction, with a secondary abrasion of the upper incisors. This limited abrasion, which did not expose the dentin in any of the teeth, may have been intentional or incidental (Hanson, 1988).

**Saipan.** In Saipan, dental filing is observed in a precontact sample of 33 commingled individuals (32 adults, one subadult) interred in a common grave at San Antonio (Pietrusewsky and Batista, 1980). At least 57.1% (12/21) of the upper dentitions and 40.6% (39/96) of the loose maxillary teeth exhibit abrasion of the labial surface. The dentin is exposed in many of the teeth. Two of the affected individuals are female; the rest are of indeterminate sex. While detailed descriptions of the teeth are not available, they are described as "culturally induced filing." However, incidental abrasion cannot be ruled out. In a reanalysis of the remains, Roy (1989) notes that the incisors and canines of one mandible also exhibit a filed appearance. The remains were dated to AD 1230–1360  $\pm$  100.



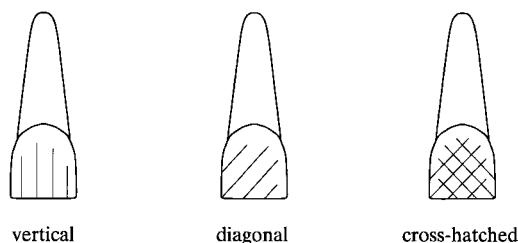


Fig. 4. Three patterns of dental incising observed in Mariana Islanders. Drawn by Roger Blankfein.

### Incising

Three patterns of incising of the labial enamel surface are observed in the surveyed samples from the Mariana Islands (Fig. 4). The first pattern, observed thus far only in the Academy Gym remains, consists of a single set of vertical lines. The second pattern consists of a single set of oblique or diagonal lines, and the third and most common pattern in the Mariana Islands is a latticed or cross-hatched pattern consisting of a set of diagonal lines crossing a second such set. The number of lines per set observed in the Mariana samples ranges from two to eight.

**Guam.** Dental incising is observed in Burial AG-20, an adult male from the Academy Gym site. Four thin, shallow vertical incisions are observed on the labial enamel surface of the maxillary right central incisor (Fig. 5). The cut grooves are located just below the gum line and extend to the occlusal edge of the tooth. The grooves are barely discernible due to their shallow nature and the fairly uniform betel staining (i.e., the grooves appear to be stained). While the first three grooves are parallel and evenly spaced, the third and fourth grooves nearly overlap and are not easily distinguishable macroscopically. Microscopic examination of the tooth surface reveals that the groove morphology is consistent with incising rather than filing. Each groove is curvilinear and uneven in width, in contrast to the relatively uniform width and straight appearance of filed grooves. The maxillary left central incisor was not recovered, precluding the determination of bilateral occurrence of incising.

In an island-wide sample of 106 precontact Chamorro crania from Guam (localities

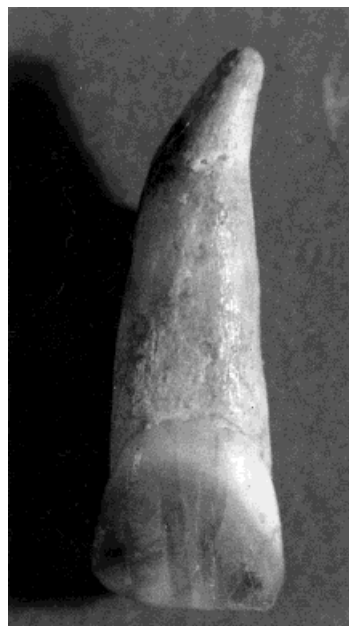


Fig. 5. Incising or cutting of the labial tooth surface of the maxillary right central incisor of an adult male from the Academy Gym site, Agaña, Guam. Tooth enlarged 3.6 $\times$ . Photo by Roger Blankfein.

unknown), cross-hatched incising of the maxillary teeth of a 45-year-old female is documented (Leigh, 1929). The alteration involves the labial surface of the incisors, canines and first premolars. The number of lines in one diagonal set (crossing a second set) varies per tooth but up to six lines are observed in a single set. Staining of the tooth surface is evident. In the same sample isolated maxillary fragments with teeth exhibiting similar modification are briefly mentioned in Leigh (1929) but no description is given. (These isolated fragments are not included in Table 2 and Figures 8 and 9.)

At Gognga-Gun Beach, Guam, three individuals display cross-hatched incising of the maxillary teeth (Anderson, 1992, pers. comm. 1993). The left incisors and canine of an adult male (40+ years), the left central incisor of an elderly female (50+ years), and the right lateral incisor of an adult female (30+ years) are affected. In one individual there are at least five diagonal lines in a set. All of the affected teeth exhibit a dark reddish-brown staining. The site dates to AD 950–1450 (Anderson, 1992).



Fig. 6. Diagonal incising of the labial tooth surface is displayed in the maxillary central incisors of an adult of indeterminate sex from Romano Maratita, Rota. Photo courtesy of Dr. Douglas Hanson, Forsyth Dental Center.

**Rota.** In a late precontact to early historic sample, dental incising is observed in a secondary burial from Romano Maratita, Rota (Hanson, 1988). An adult of indeterminate sex, one of two individuals excavated at the site, exhibits diagonal incising of the maxillary central incisors (Fig. 6). Three diagonal lines were cut into the labial surface of each incisor. Very little dentin is exposed. Staining of the tooth surface is evident, presumably from the chewing of betel nut.

Incising is observed in an adult male from the north coast of Rota. The remains of this individual (and fetal remains) were excavated in 1992 from the eastern end of the SNM Hotel project area, immediately seaward of a 10 pillar latte, and have been dated to AD 1420–1660 (Craib, in prep.). The incised teeth were not available during osteological analysis by Pietrusewsky (1994). The affected teeth were analyzed for the present study. Five maxillary teeth, the right canine through left lateral incisor, exhibit cross-hatched incising of the labial enamel sur-



Fig. 7. Cross-hatched incising of the labial tooth surface in the maxillary right central incisor of an adult male from the SNM Hotel project area, Rota. Tooth enlarged 3.9×. Photo by Roger Blankfein.

face. The right central incisor is depicted in Figure 7. The number of diagonal lines varies from two to eight per set. The left central incisor has the most incised lines, with a set of eight diagonal lines crossing a set of six diagonal lines. The maxillary premolars are not affected and the left canine was not recovered. The dental remains are stained reddish-brown; residue analysis of the organic component confirms that at least some of the staining is attributed to betel nut (Craib, pers. comm. 1996).

**Saipan.** In nine individuals (eight adults, one subadult) from the Duty Free Site, Garapan Village, Saipan, incising is documented in the maxillary teeth of two elderly individuals (Hanson, 1989). The left canine of a male and both canines of a female are affected. In both individuals one set of four diagonal lines crosses a second such set to

form the cross-hatched pattern. The teeth are stained red/orange to dark brown presumably from chewing betel nut. The rest of the anterior teeth were missing or poorly preserved. The remains date to the Latte Period (AD 1000–1521).

The cross-hatched pattern is observed in one of 20 individuals (19 adults, one subadult) from the Hafa Dai Beach Hotel site, Saipan (Pietrusewsky, 1986b). The maxillary left incisors of a middle-aged male are affected (the right incisors were not recovered). At least two lines per diagonal set are discernible. The tooth surfaces are described as stained reddish-black. The remains are believed to be precontact in origin.

In a precontact sample of 46 individuals (38 adults, eight subadults) from Afetna, San Antonio, Saipan, the maxillary anterior teeth of two adults of indeterminate sex (buried together) display diagonal incising and a third adult exhibits a cross-hatched pattern (Tayles and Roy, 1989). Both left incisors of a 25–30-year-old (the right incisors were not recovered) and all incisors and canines of a 20–25-year-old display the diagonal pattern. A 40–50-year-old male displays crossed-hatched incising of all maxillary incisors and canines. The tooth surfaces are stained reddish-brown. This site dates to approximately AD 650.

### SUMMARY AND CONCLUSIONS

While the comparative sample sizes are small and the data must be interpreted with caution, several generalizations are presented. In precontact Mariana Islanders, two types of dental alterations are observed: filing (abrading) and incising. The maxillary teeth are usually involved and the practice appears to be bilateral (i.e., when opposite sides are available both teeth are affected). Sex patterns are not discernible due to the large number of individuals of indeterminate sex, although both sexes are affected by each type of alteration. Only adults appear to be affected, although the age-at-death of one or more individuals represented by some loose teeth was not determined.

Transverse filing is observed in 18 individuals (one male, three females, 14 individuals of indeterminate sex) from five samples in the Mariana Islands. Maxillary incisors,

canines, premolars and first molars are involved. Filing of mandibular teeth is noted only in two loose teeth from Nomna Bay, Guam, and one individual from San Antonio, Saipan. In the Mariana Islands, filing appears to have been practiced as early as AD 880, possibly predates AD 490, and may occur as late as the 16th century. While this practice appears to be intentional, incidental abrasion cannot be ruled out.

Dental incising is observed in 13 individuals (six males, four females, three individuals of indeterminate sex) from eight samples in the Mariana Islands. Incising is most commonly a cross-hatched pattern occurring in 69.2% (9/13) of the affected individuals (Fig. 8). The maxillary incisors and canines are most frequently involved (38/40 or 95.0%) (Fig. 9). Premolars are rarely involved (2/40 or 5.0%) and molars are never involved. The labial surfaces of the incised teeth are also described as stained red/orange to dark brown/black, presumably from the chewing of betel nut (Hanson, 1988, 1989) although Leigh (1929) suggests that a stain may have been purposefully applied. As teeth stained from betel nut have hardness values three to five times lower in stained areas than in unaffected enamel (Stern and Hanson, 1995), stained teeth may be easier to incise than unstained teeth. Incising appears to have been practiced as early as AD 650 and possibly as late as AD 1660.

Evidence of dental abrading and incising is rare in the Mariana Islands (Table 2). In an archaeological sample, while skeletal remains may be differentially preserved, teeth tend to be very durable. The scarcity of dental modification in Guam, Rota, Tinian and Saipan may possibly reflect the rarity of these practices. It is unusual that in a precontact sample of 152 individuals from Apurguan, Guam (Pietrusewsky et al., 1992), there is no evidence of incising or abrading, yet the only two recovered dentitions from Academy Gym are culturally modified. Both types of dental modification occur at only three sites: Academy Gym and Gognga-Gun Beach in Guam, and San Antonio, Saipan. The San Antonio region (including the Afetna) has an unusually large share of the individuals displaying tooth alteration (15/31 or 48.4%).



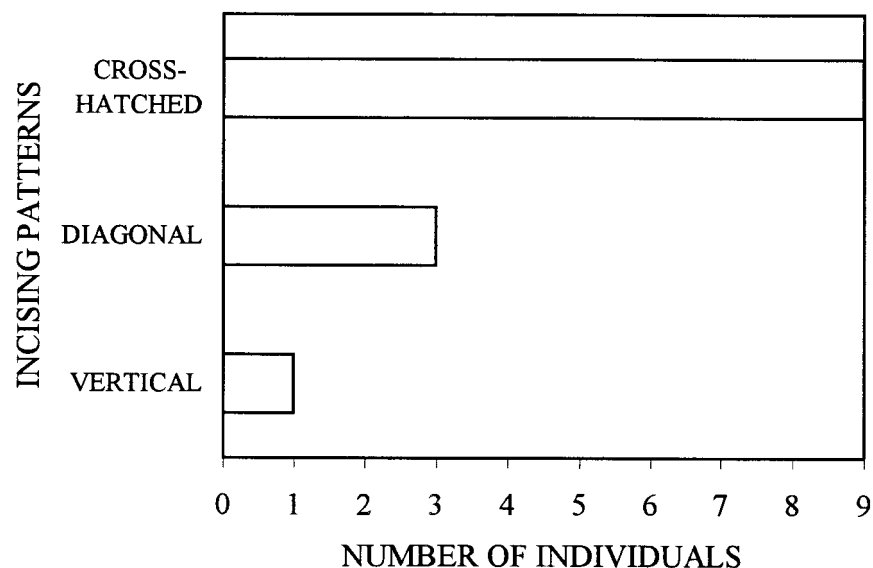


Fig. 8. Frequency of incising pattern in the maxillary teeth of Mariana Islanders (by individual).

Dental modification in the Mariana Islands may be purely cosmetic in nature or it may indicate membership to a particular group or lineage. It may alternatively indicate status in a ranked society (Hanson, 1988, 1989). As dental modification appears to be rare, it is less likely that this practice represents a rite of passage. With a larger database, a comparative assessment of

health and a scrutiny of intrasite mortuary practices may reveal differential status indicators.

In incised teeth, the pattern involved (vertical, diagonal, or cross-hatched) and the number of incised lines may be of importance (Hanson, 1988, 1989). In some of the described cases the number of lines per tooth varies for a single individual (e.g., the

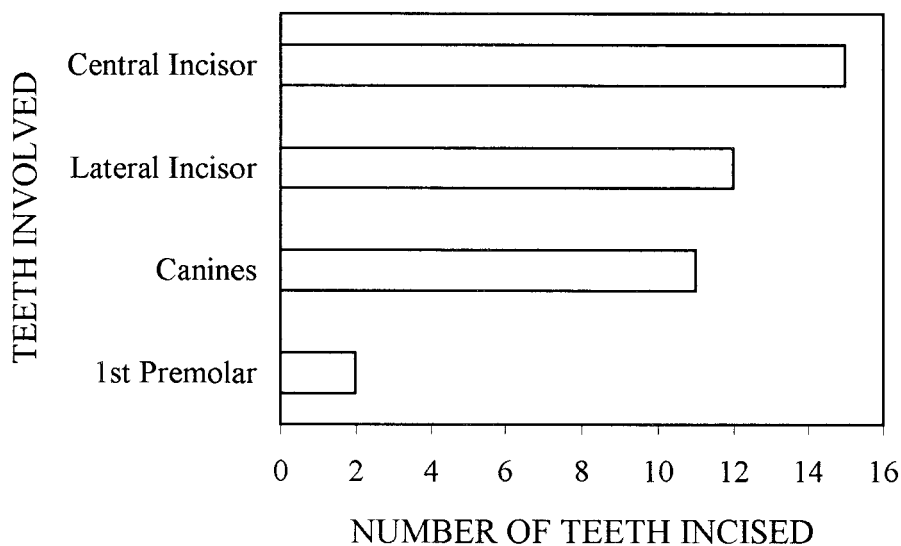


Fig. 9. Frequency of incised maxillary teeth in Mariana Islanders.

SNM Rota burial), possibly due to the available tooth surface.

While cultural practices such as drilling caries may be curative (Merbs, 1989), there is no indication that the particular alterations described in the Mariana samples represent such intentions. However, the symbolic and ritual significance of these practices is difficult to assess. Due to the lack of precise dating and the unknown provenience of many of the specimens, temporal variation cannot be ruled out. As the number of well documented and dated cases of dental alteration in the region increases, future studies may shed light on this cultural practice of the ancient Mariana Islanders.

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